Systematic measurement of keV-neutron capture cross sections and capture gamma-ray spectra of Zr isotopes

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The neutron capture cross sections of Long-Lived Fission Products (LLFPs: Se-79, Zr-93, Tc-99, Pd-107, Sn-126, I-129, Cs-135) are indispensable for the study on the nuclear transmutation of LLFPs. As for Zr-93, however, there is only one data set in the keV region[1], so we plan to measure its capture cross sections in the keV region. The preparation of Zr-93 sample is now in progress, and the sample will contain much isotopic impurity. Therefore, the capture cross sections and capture gamma-ray spectra of all stable Zr isotopes are necessary for the data analysis of Zr-93 experiment in order to derive the capture cross sections of Zr-93. From this viewpoint, we started the systematic measurement of keV-neutron capture cross sections and capture gamma-ray spectra of Zr isotopes.

A Time of Flight (TOF) method was adopted with pulsed keV neutrons from the ^{7}Li(p,n)^{7}Be reaction by a 1.5-ns bunched proton beam from the 3-MV Pelletron accelerator of the Research Laboratory for Nuclear Reactors at the Tokyo Institute of Technology. About 1 g of enriched oxide sample (ZrO_2) was prepared for each of Zr-90,91,92,94 and was contained in a graphite case with an inner diameter of 20mm. A gold (Au) sample was used as a standard. The capture gamma rays from the Zr or Au sample were detected with an anti-Compton NaI(Tl) spectrometer. The signals from the spectrometer were recorded in PC as two-dimensional data of Pulse Height (PH) and TOF. A PH weighting technique and the standard capture cross sections of Au-197 in ENDF/B-VI were employed to derive the capture cross sections of Zr isotopes. Finally, the capture gamma-ray spectra were derived by unfolding the corresponding PH spectra.

[1] R. L. Macklin, Astrophys. Space Sci., 115, 71 (1985)

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